INTERVIEWS WITH GREAT SCIENTISTS.

VI.—MAX PLANCK.

THE PARADOX OF THE QUANTUM.

SPACE AND TIME.

NO MORAL PROGRESS OF MANKIND.

BELIEFS AND "PHANTASIES."

We publish below the sixth of a series of interviews by Mr. J. W. N. Sullivan with leading men of science in this country and abroad.

The interviewer's aim has been directed less to the scientific achievement of those thinkers than to the philosophic attitude to which their work has brought them.

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Professor Max Planck has recently been appointed Director of the Kaiser Wilhelm Gesellschaft, at Berlin; but his position in the world of science is not to be measured by such academic distinctions, exalted as they may be. For there must always be a Director of the Kaiser Wilhelm Gesellschaft, whereas Planck is one of the few truly original minds of his time, creator of the revolutionary and immensely important Quantum Theory. This theory, together with Einstein's Relativity Theory, covers practically the whole of modern physics. It would hardly be too much to say that the major part of the work now being done in theoretical physics proceeds on the basis of ideas which have grown from those originally supplied by Planck thirty years ago.

In my interview with him Professor Planck replied to all my questions with a quite remarkable lack of hesitation. It would seem that his ideas on these subjects are now definitely formed, or else what he thinks with remarkable rapidity—probably both suppositions are true.

"My incentive in studying science," he said, in reply to my first question, "has been an inner drive after knowledge. But, to bring me any satisfaction, this knowledge must be free from obscurity and confusion. I have felt the need to make my knowledge more and more clear, more and more refined. I want knowledge that is, as far as possible, exact. That knowledge can be obtained, it seems to me, better through science than through anything else. Therefore I have pursued science."

AESTHETICS OF SCIENCE.

"Has not the aesthetic aspect of science also been an incentive? Have you not felt attracted by the beauty of the scientific picture of the world?"

"But certainly. The beauty of science is one of the rewards of scientific study. Truth and beauty, in science, lie very close together. But they are not the same thing. Yet they always accompany one another."

"Would you say that one aspect is more important than the other?"

"How can one decide their relative importance?" asked the Professor, smiling. "It is like asking me which is the more important, the lock or the key."

"Since beauty is so prominent an element in science, would you say that science and the arts are akin? Could science be regarded, essentially, as a great work of art?"

"There is certainly a kinship between science and art, but, at the same time, the differences are very marked. Science is a result of the desire for knowledge. The beauty of science arises from the fact that there exists a close connection between truth and beauty. This connection is probably due to the very structure of our minds. But the primary aim of the scientific man is not beauty, but knowledge. In this he differs from the artist, whose primary concern is beauty. But, in his search for beauty, the artist can also reveal to us truth and knowledge. Thus science and art are akin, and yet they are also different."

SCIENTIFIC THINKING.

"What do you think is the chief importance of science to mankind?"

"I put first the part it has played in making men more intelligent. The effort to create science has led men to adopt a certain method of thought. There are, *a priori*, various ways in which the mind can function. It can build up various fantasies, it can adopt various ways of reasoning. Which, of all these methods, is best adapted to dealing with reality? The development of intelligence is the development of the art of successful thinking. Science has shown men that, to be successful, a certain way of thinking is necessary. By pursuing this method one can gain real knowledge. Since science can be created only by correct thinking, the pursuit of science has aided the growth of intelligence. Science is also important to mankind for its practical applications."

HAS MAN PROGRESSED?

"Do you think that mankind has progressed?"

"Man has progressed in the sense that he has acquired a greater mastery of natural laws. This mastery has necessitated, as I have said, a progress in intelligence, and it has led to great material progress. For all the material advantages of our civilisation can be traced, of course, to our mastery of natural laws. Both in intelligence and in material matters, mankind has progressed."

"And morally?"

"No. I do not think there has been any moral progress."

"But surely men are less cruel than they used to be. We could not have witch-burning now, for example."

"I agree that we could not have witch-burning now, but I think that what appears as greater kindliness is merely an expression of what could be called better manners. The moral character of man expresses itself in different ways in different ages. The beliefs that led to witch-burning are no longer held. Man does not, nowadays, manifest his impulses in that way. His growth in intelligence has made such things impossible. But this does not mean that he has a kinder heart. Modern man finds outlets for his impulses along different lines, but I can see no improvement in the moral character he displays. I do not believe that man has progressed morally."

SCIENTIFIC BELIEFS AND OTHERS

"Do you think that life and consciousness are the outcome of the random action of natural laws, or do you think that they form part of some great scheme?"

"I believe that life is part of some greater life that we cannot understand. But this is not a scientific belief. It is a belief that must be justified on quite other than scientific grounds. Your question can only be answered by a fantasy."

"A fantasy?"

"A fantasy is a way of representing things to oneself in other than scientific terms. The beliefs that are expressed in a fantasy are not amenable to scientific tests. They are beliefs of a different order from beliefs that rest on scientific evidence. Your question is not one that can be decided by bringing forward scientific evidence. Nevertheless it is a question concerning which beliefs may be held."

"How are such beliefs to be justified?"

"By their influence on character. Such beliefs cannot be sincerely held without profoundly influencing character. A man's character can be the outcome of such beliefs. And the resultant character is the justification or condemnation of the beliefs. This is the only way in which such beliefs can be judged. The scientific criteria of true and false cannot be applied to them. Moral and scientific beliefs are justified on quite different grounds."

"Do you think that consciousness can be explained in terms of matter and its laws?"

"No. I regard consciousness as fundamental. I regard matter as derivative from consciousness. We cannot get behind consciousness. Everything that we talk about, everything that we regard as existing, postulates consciousness."

FREE WILL AND PHENOMENA.

In reply to another question concerning the notorious difficulties that beset modern physics, particularly in the phenomena of light, where we apparently have to use two sets of ideas that are in contradiction to one another, I found that Professor Planck considers that these difficulties illustrate the extent to which the world of science depends upon the mind. For he considers that these difficulties arise simply because we regard certain concepts as being objective realities. Thus we assume that everything that exists in nature exists in space and time. The material universe, we assume, is something that exists in space and time. When we regard certain modern scientific entities, e.g., the light-quantum, from this point of view, they seem to possess contradictory properties. Thus certain experiments show that the light-quantum is very large and other experiments show that it is very small.

Planck suggests that the light-quantum is something to which the notions of spatial and temporal extension do not apply. Men must learn to regard space and time, not as objective realities to which everything must conform, but as concepts which, in this region of phenomena, must now be transcended. They are not objective realities, independent of consciousness, and perhaps none such exist.

I found, however, that he does not share the belief, held by some of the younger physicists, that nature does not form a rigidly determined system. He admits that, in the present state of research, the so-called Principle of Indeterminacy, which puts something like free-will at the basis of phenomena, is a useful scientific tool. But he regards it merely as a temporary device, and not as a discovery concerning the ultimate character of the material universe.

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2. H. G. Wells – 28 Dec 1930
3. James Hopwood Jeans – 4 Jan 1931
4. Erwin Schrödinger – 11 Jan 1931
5. Josiah Stamp – 18 Jan 1931
6. Max Planck – 25 Jan 1931